WJEC
CBAC

MS4
£4.00

GCE MARKING SCHEME

MATHEMATICS - C1-C4 & FP1-FP3
AS/Advanced

SUMMER 2009

1 (a) Mean = 12 si B1

p-value = P($X \geq 18$ | mean = 12) M1

= 0.0630 A1

(b) X is now Po(100) which is approx N(100,100) B1

$$z = \frac{124.5 - 100}{10}$$ M1

= 2.45 cao A1

p-value = 0.00714 (FT from z) A1

Very strong evidence for concluding that the mean has increased. B1

[FT from p-value]

2 (a) (i) $$z = \frac{150 - 140}{8} = 1.25$$ M1A1

Prob = 0.1056 (FT from z) A1

(ii) Required prob = $0.1056^3 = 0.00118$ [FT from (i)] M1A1

(b) $A - R$ is N(145-140, $8^2 + 6^2$) ie N(5, 100) M1A1

$P(A < R) = P(A - R < 0)$ M1

$$z = \frac{5}{\sqrt{100}} = (\pm)0.5$$ A1

Prob = 0.3085 A1

[No FT on mean and variance]

3 (a) $$\bar{x} = \frac{66.8}{10} \quad (= 6.68)$$ si B1

SE of $\bar{X} = \frac{0.1}{\sqrt{10}}$ (= 0.03162…) si B1

[Accept variance of mean]

99% conf limits are

$6.68 \pm 2.576 \times 0.1/\sqrt{10}$ M1A1

[M1 correct form, A1 2.576, allow their mean and SE for the M mark]

giving [6.60,6.76] A1

[FT on their mean, SE and z excluding the use of 0.1 as SE]

(b) $$z = \frac{6.74 - 6.68}{0.03162}$$ M1

[FT on their SE]

= 1.90 A1

Conf level = 1 - 0.0287 × 2 = 0.9426 B1B1

[M0 for trial and improvement]

4 (a) $H_0 : \mu_x = \mu_y$ versus $H_1 : \mu_x \neq \mu_y$ B1

(b) $\bar{x} = 15.8$, $\bar{y} = 16.2$ B1

SE of difference of means = $\sqrt{\frac{0.5^2}{6} + \frac{0.5^2}{5}}$ (= 0.3027…) B1

[Accept variance]

$z = \frac{16.2 - 15.8}{0.3027}$ M1

$= 1.32$ cao A1

Prob from tables = 0.0934 cao A1

p-value = $2 \times 0.0934 = 0.1868$ (FT from line above) B1

Mean times are equal (oe) (FT from p-value) B1

5 (a)(i) E(X) = 8 B1

(ii) Var(X) = 4.8 B1

Using Var(X) = $E(X^2) - [E(X)]^2$ M1

$E(X^2) = 4.8 + 64 = 68.8$ A1

(b) Var(Y) = μ B1

using Var(Y) = $E(Y^2) - [E(Y)]^2$ M1

$\mu = 9.36 - \mu^2$ A1

$\mu = 2.6$ cao A1

(c) E(U)=E(X)E(Y) = 20.8 B1

$E(U^2) = E(X^2)E(Y^2) = 643.968$ B1

Var(U) = $E(X^2Y^2) - [E(XY)]^2$ M1

$= 643.968 - 20.8^2 = 211.328$ A1

[FT their values from (a) and (b) – allow a multiple of μ in first line]

6 (a)(i) $f(x) = \frac{1}{7}$ B1

(ii) $F(x) = \int_9^x \frac{1}{7}\,\mathrm{d}u$ M1

$= \left[\frac{u}{7}\right]_9^x$ A1

$= \frac{x-9}{7}$ A1

(b)(i) $\mathrm{E}(Y) = \int_9^{16} \sqrt{x}.\frac{1}{7}\,\mathrm{d}x$ M1

[no limits required for M mark]

$= \frac{1}{7} \times \left[x^{1.5} . \frac{2}{3} \right]_9^{16}$ A1

$= 3.52$ A1

(ii) The median m satisfies

$P(Y \le m) = 0.5$ M1

$P(\sqrt{X} \le m) = 0.5$ A1

$P(X \le m^2) = 0.5$ A1

$F(m^2) = \frac{m^2 - 9}{7} = 0.5$ M1

$m = 3.54$ A1

[FT their $F(x)$ from (a)]

7 (a) $H_0 : p = 0.7$ versus $H_1 : p > 0.7$ B1

(b) Under H_0, X (No cured) is B(50,0.7) B1

and Y (No not cured) is B(50,0.3) (si) B1

p-value = $\mathrm{P}(X \ge 40) \mid H_0)$ M1

$= \mathrm{P}(Y \le 10 \mid H_0) = 0.0789$ A1

The new drug is no better B1

(c)(i) X is now B(250,0.7) which is approx N(175,52.5) M1A1

$z = \frac{189.5 - 175}{\sqrt{52.5}}$ M1

$= 2.00$ cao A1

Sig level = 0.02275 (FT from their z) A1

(ii) X is now B(250,0.8) which is approx N(200,40) M1A1

$z = \frac{189.5 - 200}{\sqrt{40}}$ M1

$= -1.66$ cao A1

Prob = 0.0485 A1